

U.S. CENSUS OF AGRICULTURE : 1959

Final Report—Vol. IV

DRAINAGE PROJECTS • SIZE

TYPE • AREA SERVED

COST • WORKS

The United States

DRAINAGE OF AGRICULTURAL LANDS

Prepared under the supervision of
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PREFACE

Volume IV—Drainage of Agricultural Lands—presents the results of the 1960 Census of Drainage. Data were collected for both organized drainage projects and for individually owned tracts, provided 500 or more acres of land were benefited for agriculture by installed works. The information was collected by both mail and field enumeration from officials and records of organized projects, from county and court records, and from individuals who had knowledge of known projects.

The 1960 Census of Drainage was taken in conformity with the Act of Congress of August 31, 1954 (amended August 1957), which codified Title 13, United States Code.

The planning of the census and the compilation of the statistics, in large measure, were carried on by Hilton E. Robison, Drainage Statistician, under the supervision of Ray Hurley, Chief, Agriculture Division. Assistance was given by Warder B. Jenkins, Assistant Chief, William B. Kauffman, Henry A. Tucker, and Helen D. Turner. The field canvass was conducted under the supervision of Robert B. Voight, then Chief, Field Division, by enumerators trained by employees of the Agriculture Division. The maps were prepared under the supervision of William T. Fay, Geographer.

Acknowledgment is made of the technical assistance of a Special Federal Agency Committee—1959 Censuses of Irrigation and Drainage—and of the central office and local personnel of the United States Soil Conservation Service.

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UNITED STATES CENSUS OF AGRICULTURE: 1959

FINAL REPORTS

Volume I—Counties—A separate part for each State. Statistics on number of farms; farm characteristics; acreage in farms; cropland and other uses of land; land-use practices; irrigation; farm facilities and equipment; farm labor; farm expenditures; use of commercial fertilizer; number and kind of livestock; acres and production of crops; value of farm products; characteristics of commercial farms, farms classified by tenure, by size, type, and economic class; and comparative data from the 1954 Census of Agriculture.

Volume I is published in 54 parts as follows:

Part	State or States	Part	State or States	Part	State or States
1	New England States:	19	West North Central—Continued	38	Mountain:
2	Maine.	20	South Dakota.	39	Montana.
3	New Hampshire.	21	Nebraska.	40	Idaho.
4	Vermont.		Kansas.	41	Wyoming.
5	Massachusetts.	22	South Atlantic:	42	Colorado.
6	Rhode Island.	23	Delaware.	43	New Mexico.
7	Connecticut.	24	Maryland.	44	Arizona.
8	Middle Atlantic States:	25	Virginia.	45	Utah.
9	New York.	26	West Virginia.		Nevada.
10	New Jersey.	27	North Carolina.	46	Pacific:
11	Pennsylvania.	28	South Carolina.	47	Washington.
12	East North Central:	29	Georgia.	48	Oregon.
13	Ohio.		Florida.	49	California.
14	Indiana.	30	East South Central:	50	Alaska.
15	Illinois.	31	Kentucky.		Hawaii.
16	Michigan.	32	Tennessee.	51	Other Areas:
17	Wisconsin.	33	Alabama.	52	American Samoa.
18	West North Central:		Mississippi.	53	Guam.
	Minnesota.	34	West South Central:	54	Puerto Rico.
	Iowa.	35	Arkansas.		Virgin Islands.
	Missouri.	36	Louisiana.		
	North Dakota.	37	Oklahoma.		
			Texas.		

Volume II—General Report.—Statistics by Subjects, United States Census of Agriculture, 1959. Summary data and analyses of the data by States, for geographic divisions, and for the United States, by subjects, as illustrated by the chapter titles listed below:

Chapter	Title	Chapter	Title
I	Farms and Land in Farms.	VII	Field Crops and Vegetables.
II	Age, Residence, Years on Farm, Work Off Farm.	VIII	Fruits and Nuts, Horticultural Specialties, Forest Products.
III	Farm Facilities, Farm Equipment.	IX	Value of Farm Products.
IV	Farm Labor, Use of Fertilizer, Farm Expenditures, and Cash Rent.	X	Color, Race, and Tenure of Farm Operator.
V	Size of Farm.	XI	Economic Class of Farm.
VI	Livestock and Livestock Products.	XII	Type of Farm.

Volume III—Irrigation of Agricultural Lands. Western States (Dry Areas)—Data by States for drainage basins and a summary for the area, including number and types of irrigation organizations, source of water, expenditures for works and equipment since 1950, water used and acres served for irrigation purposes.

Volume IV—Drainage of Agricultural Lands. Data by States on land in drainage organizations, number and types of organizations, cost of drainage and drainage works.

Volume V—Special Reports, Part 1.—Horticultural Specialties. Statistics by States and a summary for the United States presenting number and kinds of operations; gross receipts and/or gross sales; sales of nursery products, flower seed, vegetables grown under glass, and propagated mushrooms; number of container-grown plants; inventory products; sales of bulb crops; employment; structures and equipment.

Titles of additional parts of this volume are not available as this report goes to press.

DRAINAGE OF AGRICULTURAL LANDS

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INTRODUCTION

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INTRODUCTION

DRAINAGE OF AGRICULTURAL LANDS

Presentation of data.—This volume presents statistics on drainage of agricultural lands collected in the 1960 Census of Drainage. The 1960 Census included drainage projects that were benefiting 500 or more acres of agricultural land. The statistics are for areas benefited, 1960, and for drainage operations for the 10-year period, 1950 through 1959. In the presentation selected comparative data are included for earlier censuses. In general, the censuses of drainage have primarily covered community or public drainage undertakings although individual ownership undertakings have been included if the area benefited met the minimum acres requirement.

Data are presented for counties, for States, and for the combination of States, which comprise the conterminous United States, in which drainage enterprises were reported. Maps are utilized to show the approximate location and boundaries of the areas receiving drainage benefits, as ascertained in 1960. Data for the conterminous United States are first presented in a series of summary tables and in an overall map. Several summary tables include information for States. These summary tables and the general drainage map are followed by the tabular data and a map for each State. Each State presentation is accompanied by detailed information for individual counties.

General discussion.—Agricultural drainage refers to the removal, by artificial means, of excess water to improve the condition of land used or to be used for agriculture. Excess water either in or on the soil—whether a temporary or a permanent condition—influences farm production, farm income, and farm values. Too much water in the soil adversely affects crop growth and the timely performance of operations such as tillage, seeding, cultivating, and harvesting including pasturing. Accumulation of excess water may come about from heavy local precipitation; from runoff from upstream areas; from low-lying land in depressions, ponds, and lakebeds; from tidal action in coastal areas; from soil profiles which restrict subsoil drainage; from buildup of a high water table directly as a result of irrigation or from seepage; or from artesian or other underground movement of water.

Good management of land requires management of water. Drainage, irrigation, and flood control, all requiring management, often are interrelated. Large investments of capital have been made by the Federal government and other public or quasi-public organizations; by cooperating groups of individuals; or by single individuals to restrict, provide, or regulate water supplies. On the drainage side, Federal assistance has included measures which provide improved major drainage outlets which may be interrelated with flood control. Secondary drainage works and drainage improvements on private land have been usually undertaken by non-Federal interests, including private landowners. More recently, increased Federal drainage assistance has been available to local agencies, with some limitations, through the watershed protection and flood prevention program authorized under Public Law 566 of 1954 and amendments.

Drainage of land for agriculture has generally been recognized, directly or tacitly, as a public good. As a general rule, the drainage of an individual's land cannot be carried out without the construction of an artificial drain or the improvement of a natural watercourse which affects the land of other individuals. Usually, the improvement of an outlet drain benefits more than one farm

and the cost is greater than any individual wants to assume. Most States have passed laws permitting or encouraging the organization of public corporations or local improvement districts for this purpose.

Previous to the earliest acts for establishing public drains, a number of the States had recognized the right of every landowner to a drainage outlet by providing that an owner desiring drainage could apply to a designated official and upon payment of damages, if the necessity were proved, secure easement to construct and maintain a private drain across his neighbor's land. The drainage laws for the various States have given rise to two principal types of organization and to several minor types. The corporate district and the county drain are the principal types. The first is governed by its own officers, who either are elected by the residents or landowners of the district or are specially appointed by the authority which creates the enterprise. The county drain is established and constructed as any other public work or local improvement, the enterprise being managed by regular officers who have charge of all these enterprises in their county. Some enterprises are administered by a commission or board consisting of one or more officials of the county and one or more members selected by the owners of the land assessed for the cost of the drainage. The minor types of organizations include (1) township drains, which are similar in form to county drains but are controlled by officers of the townships; (2) State drainage projects, controlled by State officials, usually embracing some State land; (3) irrigation districts, similar in character to drainage districts, that have undertaken drainage of land in those districts; (4) commercial companies reclaiming and improving wetland for sale; (5) cooperative or mutual undertakings without formal corporate organization; and (6) individual landowners including farm partnerships and farm corporations.

Physiographic features and the amount of water that should be removed from both surface and subsoil have a direct bearing on the need for, and the nature of, drainage works. Drainage improvements can be in the nature of straightening and deepening natural water channels; construction or replacement of drains, both open and closed types; installation or use of pumps and drainage wells; construction or repair of levees, floodgates, culverts, and bridges; and land leveling. Millions of acres now in agricultural use have been fitted for crop or livestock production by one or more of the methods which hasten the removal of excess water. Some of the most productive lands of the Nation have been improved by drainage and the installation of a drainage work increases agricultural output.

Drainage problems still exist on many acres of farmland. Old or new techniques can make these lands more physically suitable for crops and pasture. A part of the lands still inadequately drained are interspersed with lands adequately provided with drainage. Often an organized drainage district or other collective drainage enterprise has provided the main channels and an outlet for water flow so that remaining works need only be installed by individual landowners. There are extensive areas of wetlands, without or within farm boundaries, without any artificial drainage, whatever, which can be physically improved for crops and pasture. It may be questionable whether it is advisable to make such lands fit for agriculture, or even to make all lands presently in farms fit for a higher type of agriculture,

by means of drainage. This is especially true in periods of farm surpluses. Often wildlife propagation and recreational activities may be more desirable alternative uses of wetlands. There are cases where the health of a community must be given consideration. No doubt the individual landowner usually visualizes some economic gain before he undertakes a drainage improvement. Economic as well as social factors need to be weighed to determine the feasibility and advisability of reclaiming land for farming. Prevailing costs and benefits have not always been sufficient to warrant the maintenance of drainage works after their installation. With the passage of time, it becomes difficult to say whether certain drainage works are still a benefit to agriculture.

History of the Census of Drainage.—Practically all drained agricultural lands lie within the boundaries of operated farms. Such lands may be either inside or outside the boundaries of an organized enterprise that provides drainage works for improving lands for agriculture. The drains and other works for control of water that a farmowner installs upon his own farm, either within or without the boundaries of an organized drainage enterprise, are likely to be either supplemental to or entirely independent of the works installed by an organized enterprise. Officials of an organized enterprise cannot be expected to know in detail the total acres drained or the nature of all drainage works, including those constructed by individual landowners, within the boundaries of their districts. Therefore, the first efforts at gathering information for drainage attempted the full coverage of drainage for farmlands, that is, drainage by both organized enterprises and by individual landowners.

Through the years, a varying amount of basic information has been obtained in respect to the amount and location of farmlands which have been improved by drainage, the type of organization under which drainage has been carried out, the kind of works installed, the purpose of the drainage, the adequacy of the drainage, the capital invested, and the financial situation of the enterprise established for carrying on drainage improvements. Recently, more emphasis is being placed on additions to the drained area in respect to acreage, physical works, and costs. It has been learned that many of the needed data concerning the extent and adequacy of drainage cannot be answered satisfactorily by local officials or individual landowners. Some organizations cease to function after the drainage work has been accomplished and, for farm drainage, the individual landowner either may be difficult to locate in the case of tenant-operated land or may not be in full possession of knowledge of drains long-established on his holdings.

The first census of drainage in the United States was taken in 1920. No provision for inquiries regarding drainage was made in any prior census. In 1920, some facts concerning drainage on farms were collected in the general census of agriculture, while those for drainage enterprises were obtained in a special canvass of those enterprises. Drainage enterprises were to comprise public and private corporations and local improvement districts organized to secure the drainage of land to be used for agricultural purposes; also government projects and other organizations engaged in extensive land drainage work. Questionnaires were obtained also for drainage undertakings, each to benefit 500 acres or more, by individual farmowners. Land furnished protection from overflow by levees, dikes, or embankments was not included unless some form of drainage works had been constructed on the protected land. The land in drainage enterprises was the acreage that had been or was to be benefited by drainage works constructed by the enterprises and, except in a few instances, was the land assessed to pay the cost of the enterprises. The exceptions were irrigation projects installing drains to benefit land damaged by seepage or by alkali as a result of the irrigation, and assessing the cost against the entire irrigation enterprise instead of against only the area needing drainage or protection. Under such circumstances the area thus assessed, but not need-

ing drainage, was omitted from the tabulations. Enterprise data were published for 34 States. No enterprises were found in Alabama, Virginia, West Virginia, or in the 11 States north of the Potomac River.

In 1930, a small amount of data was gathered from farm operators in the general census of agriculture in respect to drainage on farms. Figures were published for the number of farms reporting drainage and the acreage of farmland provided with drainage. A special questionnaire was utilized to cover organized drainage enterprises. Again, the term "drainage enterprise" was broadened to include a tract of farmland of 500 or more acres drained as a private undertaking without legal organization. The area of a drainage enterprise included all the land within the boundaries of the enterprise. It included all land assessed for the cost of the enterprise, and may have included land not assessed because exempted for special reasons. Where the drainage was performed by an irrigation district, that district was also the drainage enterprise. Drainage enterprise data were published for 35 States in 1930. These included Virginia in addition to the 34 States for which data were published in 1920.

Since 1930, no effort has been made to obtain drainage data on the general questionnaire for the census of agriculture. The acreage drained in a particular farm is largely a matter of opinion of the operator, particularly so in the case of a tenant-operator, as to the area actually benefited. The 1930 Drainage Report stated that both the number of farms reporting drainage and the acreage drained were doubtless too low, due to the fact that some enumerators failed to secure answers to the farm drainage questions on the general farm questionnaire.

The third census of drainage enterprises was taken in 1940. A drainage enterprise, for the 1940 Census of Drainage, was defined as the area (1) organized in one drainage district, or (2) assessed for the same public drain, or (3) in corporate or in private ownership drained by works operated as one undertaking. Privately owned enterprises draining less than 500 acres each were omitted from the census, but all enterprises established under State drainage laws were included. Drainage statistics were presented for 38 States. In addition to the 35 States for which enterprises had been found in the 1930 enumeration, enterprises were located in, and statistics were published for, Alabama, Delaware, and Maryland.

In the 1940 Census of Drainage Report, in the discussion of the classification by character of enterprise, mention was made of the difficulty of applying the definitions to distinguish between drainage districts and county drains in all States. In Iowa, for example, almost all of the enterprises were classed as county drains although by law they were named drainage districts. In several other States an enterprise with the term "district," as used locally or even in the statutes, was classified differently. It was said that the district form of organization, being under the management of its own officials, was generally considered more suited to the larger and more costly undertakings, as giving the landowners the greatest degree of local control. The county drain form, administered by county officials, was generally more economical in administrative costs for small enterprises in which the problems of engineering and financing are relatively simple. This form was most common in those States where drainage was promoted for improving land already in farms. The district form was general in those areas where reclamation and development of unimproved lands for making new farms had been an important consideration in promoting the drainage enterprises.

Prior to 1950, all organized drainage enterprises, regardless of size, were covered in each census of drainage. A report was obtained for each enterprise that had constructed drainage works which were still serving agricultural lands or that had contributed to the capital invested in existing works. All unorganized drainage operations on agricultural lands of 500 or more drained acres, conducted by individuals or cooperative groups, were also covered.

For 1950, it was decided to restrict the enumeration of drainage projects to drained agricultural areas of 500 acres or more, regardless of whether they were in an organized enterprise or represented a private operation. Consideration was given to both the expense and difficulty of gathering information for individuals or officials for small acreages of drained lands. These items are more pronounced for those enterprises which have been superseded. Many of the small enterprises had been superseded by later enterprises. For that reason it was decided, in advance of the 1950 Census date, to eliminate enterprises of less than 500 acres from the enumeration. For 1950, a special effort was made to obtain reports for cooperative or group drainage projects to which the Soil Conservation Service had rendered technical assistance.

The decision to limit the 1950 Census of Drainage to enterprises of 500 or more drained acres was based on the following facts. In 1940, there were 79,220 reports secured in the Census of Drainage. Many of these represented enterprises which had been superseded by later enterprises. Although these superseded enterprises were no longer in existence, the works which they had constructed were still serving to drain agricultural lands, or these enterprises had contributed to the capital invested in existing works. Of the 79,220 total, 41,690 were less than 500 acres in size. Of approximately 133 million acres in all enterprises in 1940, only 9 million acres were accounted for by enterprises under 500 acres. Thus, slightly more than half of the enterprises containing about seven percent of the land in enterprises were represented by these small operations. In 1940, about 87 million acres of land were drained. The difference between 133 million and 87 million represented lands which were drained by more than one enterprise. Considerably more than one-half of the land in enterprises of less than 500 acres was shown to be in overlapped enterprises. The exclusion of the very small enterprises had a material effect on the number of enterprises covered but had only a minor effect on the number of drained acres.

Prior to the 1950 Census of Drainage, a preliminary field test was conducted in Ohio, Indiana, and Illinois to determine whether a satisfactory method of enumerating overlapped drainage enterprises had been developed. It was learned that in most of the counties having county drains, there were county maps showing the land in drainage enterprises. These maps were usually prepared by the county engineer or other qualified person. The existing maps and the special knowledge of county engineers or surveyors as to the location of the drained lands could be used to best advantage if overlapped lands in enterprises could be eliminated from the enumeration. This elimination would greatly reduce the cost of both field and office work. It was decided to treat the drained lands of each county, in States having predominantly county drains, as a single enterprise. Thus, only one questionnaire would be filled per county in such States. Most of the overlapped enterprises, and also those under 500 acres, were in three States—Ohio, Indiana, and Michigan. The same economies which prompted the Census to use one questionnaire per county in these three States led to the use of a single questionnaire per county also in Delaware, Iowa, Kentucky, Minnesota, Oklahoma, North Dakota, and South Dakota. This group of ten States was designated as "county-drain" States, although in Delaware the predominant form of drainage organization was the drainage district. An abbreviated questionnaire was used in these "county-drain" States as contrasted with the reporting form used in the other so-called "drainage-district" States.

In 1950, the enumerators who were charged with the responsibility of securing a drainage questionnaire for irrigation enterprises having their own drainage were often unable to obtain the required information concerning the area and location of the lands benefited by drainage. They could not readily secure an allocation of cost, collections, and indebtedness for the drainage

works separately from the irrigation works. Because of this difficulty, the 1950 information concerning drained lands was supplemented by data secured on the questionnaire for the census of irrigation. In doing so, the restriction of 500 or more drained acres was not applied to irrigation enterprises having their own drainage.

Drainage enterprises were enumerated in 40 States in 1950. Enterprises were enumerated in New Jersey and New York for the first time. The eight States with no drainage enterprises, for the purpose of the census, were the six New England States, Pennsylvania, and West Virginia.

The 1960 Census of Drainage was the fifth of a nationwide series to obtain data in respect to removal of excess water from agricultural lands. After the 1950 experience, a change was considered necessary in the kind of data that could or should be secured in a drainage enumeration. Lands drained solely because of irrigation, to remove seepage water, or to prevent alkali accumulation, were excluded from the Census of Drainage. The theory underlying the change was that these irrigated lands were not first made available for agricultural use through the removal of excess water from naturally wetlands. (See discussion under "Scope of the 1960 Census of Drainage.")

Legal basis for the Census of Drainage.—Each of the five censuses of drainage has been authorized by an Act of Congress. "Title 13, United States Code—Census," codified in August 1954, and amended in August 1957, and September 1960, is now the legal basis for the censuses of agriculture and other censuses, and surveys conducted by the Bureau of the Census. Section 142, paragraph (b), made provision for the Census of Drainage, as follows:

"The Secretary shall, in conjunction with the census of agriculture directed to be taken in October 1959 and each tenth year thereafter, take a census of irrigation and drainage."

Section 5 of Title 13 made provision for the preparation of forms and questionnaires in this manner—

"The Secretary shall prepare schedules, and shall determine the inquiries, and the number, form and subdivision thereof, for the statistics, surveys, and censuses provided for in this title." Under authority granted by Section 4 of Title 13, the Secretary of Commerce delegated "the functions and duties imposed upon him by this title" to the Director of the Bureau of the Census.

ENUMERATION FORMS AND PROCEDURES

Preparatory work.—Within the framework of the Act providing for the 1960 Census of Drainage, the scope of the enumeration and the nature and content of the forms and procedures used for taking the census were determined by the staff of the Bureau. In making the decision as to which drainage projects to enumerate, the form of the questions to be asked, and the enumerative procedures to be followed, the staff gave consideration to the experience gained in earlier censuses and to the results of a pretest of the proposed questionnaire and procedures. Careful consideration was given to availability of data from other sources, the adequacy of the data that might be obtained, and the need for and the usefulness of the data.

Two special committees provided advice and counsel to the Bureau. A Special Federal Agency Committee, for the 1959 Censuses of Irrigation and Drainage, comprised representatives of the following agencies: Agricultural Conservation Program Service, Agricultural Research Service, Rural Electrification Administration, and Soil Conservation Service of the U.S. Department of Agriculture; Bureau of Indian Affairs and Bureau of Reclamation of the U.S. Department of the Interior; and the Bureau of the Census. A second Committee, the Special Advisory Committee for the 1959 Census of Agriculture, reviewed the later stages of the planning. This committee consisted of one repre-

sentative from each of the following: Agricultural Publishers Association; American Association of Land-Grant Colleges and State Universities; American Farm Bureau Federation; American Farm Economic Association; American Statistical Association; Farm Equipment Institute; National Association of Commissioners, Secretaries, and Directors of Agriculture; National Council of Farmer Cooperatives; National Farmers' Union; National Grange; Rural Sociological Society; and the U.S. Department of Agriculture. A representative of the Bureau of the Budget was in attendance at all meetings of this Committee.

Scope of the 1960 Census of Drainage.—Since drainage of irrigated lands for the purpose of controlling alkali or seepage from irrigation generally represents an integral part of the operations performed by irrigation enterprises, such drainage was excluded in the 1960 Census. The 1950 experience had indicated the impracticability of apportioning financial data to drainage, as distinct from irrigation. Drainage for control of alkali or seepage from irrigation was excluded even in instances where the drainage was handled by a separate organization from that which provided the irrigation. In such cases the drainage organization was often a subsidiary of the irrigation organization and, even when not subsidiary, the organizations often shared facilities. Part or all of the maintenance was frequently handled by the irrigation organization. An attempt was made, however, to include drainage operations benefiting naturally wetlands even though such lands may have been irrigated.

The 1950 experience also led to the inclusion in 1960 of inquiries designed to identify extensive contiguous tracts within the project area that were either not being used for agriculture or were receiving no drainage benefits from the facilities provided.

The principle established in 1950 for the "county-drain" States of obtaining one report for all drains under one management was extended in 1960 to all States. The 1950 plan for "county-drain" States was modified to require separate reports for drainage projects under separate management.

The 1960 enumeration, as in 1950, included all projects which provided drainage benefits to 500 or more acres of agricultural lands. A project might represent an undertaking by a legally organized drainage district; by a special district organized primarily to provide some other service; by some other governmental unit; by an individual landowner, farm partnership, or farm corporation; or by a cooperative group of landowners controlling a joint undertaking or carrying out their respective portions of one overall plan.

For intercounty projects separate reports, as in prior censuses, were required for each county part in order to provide drainage data at the county level.

Projects for which the drains still were functioning were included even though the organization responsible for the drains no longer existed. An exception was made for projects taken over by a later organization. If, however, there had been any drainage activity by the superseded organization during the 10-year period, 1950-1959, it was also included.

Information was obtained on the area of the project and for drainage activities for the 10-year period since the preceding census. Where possible, information obtained for the project in 1950, such as the area in 1950 and the mapping of this area, was utilized in 1960 and only the activities and changes since 1950 were recorded by the enumerator in the 1960 enumeration. However, if the 1950 Census records were incomplete, or indicated a need for verification, or if the recorded information was found to be incorrect, the enumerator was required to disregard any information given him for the 1950 Census and to obtain complete information for the project for 1960.

Pretest of questionnaire and procedures.—A pretest of the questionnaire and field procedures was conducted in July 1959. Four counties were selected to provide a fairly representative

cross-section of the problems expected in the enumeration. Vanderburgh County, Indiana, and Henderson County, Kentucky, represented county-drain systems with drains under control of county officials. The county surveyor was directly responsible for county-drain work in Vanderburgh County, Indiana, and a county Board of Drainage Commissioners was responsible for the county ditches in Henderson County, Kentucky. Indiana and Kentucky were enumerated in 1950 as "county-drain" States, one questionnaire being used to enumerate all drainage projects in each county. Massac County and Gallatin County, Illinois, were selected as representative of "drainage-district" areas. For these two counties, each drainage district had its own officials with varied connections with the county government. Massac County was selected particularly to test the effectiveness and adequacy of the questionnaire and procedures for handling projects that extend into two or more counties. [The 1950 enumeration included 618 such projects, in all areas, accounting for 1,292 of the 6,132 reports (other than "irrigation enterprises" enumerated in the Census of Drainage) included in the tabulations for that year.] Gallatin County had projects of several types of organization. It offered experience in handling problems involving overlapping of projects, in obtaining information from a variety of sources, and in obtaining information for projects for which there was no longer any active management or person responsible.

Advance listing of drainage projects.—Just prior to the field enumeration for the 1960 Census of Drainage, a listing of drainage projects was prepared to insure reasonably complete coverage. This listing included the following:

1. All projects included in the 1950 tabulations.
2. Additional projects, listed or enumerated in 1950 but excluded from the tabulations, where there was a possibility that such projects might qualify for inclusion in 1960. These additional projects included those in the planning stage in 1950, projects started but not completed, and projects reported inactive for many years but which might have been restored.
3. Special purpose districts included in the 1952 and 1957 Censuses of Governments where the name or listed functions of the district indicated that the district might be providing drainage services to agricultural lands.
4. Projects ascertained by a mail canvass of "irrigation enterprises" reporting 500 or more acres of drained lands in the 1950 Census of Irrigation. (See "Canvass of irrigation enterprises.")
5. Projects listed by the Soil Conservation Service as having been undertaken since 1950. (See "Soil Conservation Service canvass.")
6. Projects listed by the State of Missouri as having been organized since January 1, 1950. (The Soil Conservation Service could provide no information on drainage activities for 77 Missouri counties.)

For each of these listed projects, the name of the organization was entered on a 1960 Drainage Questionnaire. In most instances, the Bureau was also able to enter the name and address of one or more persons who could be contacted regarding that project. The person listed was generally an official of the organization, or some other person who would have knowledge of the project. These questionnaires were given to the enumerator, in the respective area, in advance of the enumeration.

The listing was considered to be reasonably complete. The 1950 Census provided a reliable listing of projects in existence as of that date. Officials of the Soil Conservation Service were of the opinion that the listing provided by that organization could be relied upon for coverage of additional projects since the 1950 Census. The Soil Conservation personnel had rendered technical assistance for many of these projects. Since the area served by each local office of the Soil Conservation Service generally consists of only one or two counties, the local officials should have had knowledge of any additional drainage operation in their area that would have sufficient size for inclusion in 1960.

Enumerators were instructed to be on the lookout, in the counties assigned, for additional drainage activities that might qualify for inclusion in the census.

For counties for which no projects were prelisted, and counties for which the enumeration was conducted by mail (see "Mail canvass"), the enumeration coverage depended wholly on the advance listing.

Canvass of "irrigation enterprises."—To determine which "irrigation enterprises" included in the 1950 Census of Drainage qualified for inclusion in the 1960 Census of Drainage, a special questionnaire (Form D2) was mailed to each enterprise for which 500 or more acres of land were reported as provided with artificial drainage. This questionnaire determined—

1. The individual or the organization responsible for the drainage.
2. Whether the need for drainage was solely because of irrigation, or was intended to improve naturally wetlands.
3. Whether 500 or more acres were drained by constructed works.

Although the 1950 Census of Drainage report carried data for "irrigation enterprises having their own drainage," the 1950 Census of Irrigation questionnaire did not determine whether the organization, group, or person responsible for the irrigation was also responsible for the drainage of the land.

The mailing list was compiled from the 1950 Census of Irrigation reports and from incomplete 1950 Census of Drainage questionnaires representing "irrigation enterprises" having their own drainage works. The 1950 Census of Drainage included 790 "irrigation enterprises" enumerated in the Irrigation Census, with 500 or more acres of irrigated land reported as provided with artificial drainage. The mailing list, compiled on a county basis, consisted of 960 listings to be accounted for. A total of 1,683 mailings was made, including followups for nonresponses, requests for further information, and requests to new respondents named as responsible for the drainage activities.

Satisfactory information was obtained for 87.9 percent of the listings. For most of the others the identification or address was not sufficient to find a satisfactory respondent. Of those for which satisfactory information was obtained, approximately two out of three did not qualify for inclusion in the 1960 Census. For over half (54.2 percent) of those qualifying for inclusion, the drainage was by separately organized drainage districts. Nearly all of these separately organized districts represented projects already listed. Only 99 projects qualifying for inclusion in the 1960 Census of Drainage, and not already listed from other sources, were found as a result of this canvass of "irrigation enterprises."

Soil Conservation Service canvass.—At the request of the Bureau, the officials of the Soil Conservation Service, Washington, D.C., asked each of the State conservationists to require that their work unit conservationists prepare a list of drainage operations for each county in their respective areas.

The work unit conservationists were instructed to include "only projects that provide drainage benefits for approximately 500 or more acres of land for agriculture" and to include only "jobs completed or started since January 1, 1950." They were requested to include "all projects—group, individual, and public—irrespective of whether they received technical assistance from the Soil Conservation Service."

The listing form provided for the inclusion of the name of the project; the approximate acres benefited; whether the project represented a single farm, a cooperative or mutual, or a legally organized project; and the name and address of the person or persons who might be contacted for information concerning the physical works and costs, and for maps or plats. Facsimiles of the listing form and of the covering memorandum are included in the appendix.

The projects for which lists were received totalled 4,602 for 610 counties. For each of the other counties, except for 77 counties in Missouri for which officials of the Soil Conservation Service were unable to provide information, either a listing form checked "No projects" or a memorandum stating there were no such projects, was received.

As a result of this prelisting of projects by the Soil Conservation Service, 2,935 projects were added to the Census lists. Of the 9,298 drainage projects (county count) in 1960, more than one-fourth (2,456) represented projects that had been added to the advance listing as a result of the Soil Conservation Service canvass. Of the 4,602 projects listed in the Soil Conservation Service canvass, 2,146 represented projects already listed by the Census, or projects that were found as not qualifying for inclusion.

In the field enumeration, further information obtained from the Soil Conservation Service local offices accounted for a large proportion of the 532 additional projects found by Census enumerators.

The drainage questionnaire.—For the 1960 Census, the same questionnaire form (D1) was used for all States. A facsimile of this questionnaire appears in the appendix.

In the arrangement and design of the questionnaire, consideration was given to the use of the form for self-enumeration, maximum use of 1950 information as a guide to the enumerator, simplification in the enumeration, and for the office processing of the data.

The name of the State and county were placed at the beginning of the questionnaire, since they assisted in the identification of a project. For intercounty projects, the portion in each county was enumerated separately and the inquiries, therefore, referred only to the portion within the specified county.

Section I provided for the identification and organization of the project. For all prelisted projects, the identification was entered in advance of the assignment for enumeration. Other inquiries related to the type of organization, the period in which the project or organization was started, and, if an intercounty project, the names of the other counties in which the project lands were situated.

Supplementary information, useful in the processing of the data, was sought through inquiries on whether there was active management of the project, and, if not, whether the project or organization had been dissolved, and whether the organization provided any major public service other than drainage.

Section II was designed to record the drainage activities during the decade, 1950–1959. A series of "No-Yes" questions described the various types of drainage activity and provided for skipping of the remainder of the section if there was no drainage activity. Data were requested for the cost of all drainage works and services, for the physical quantity of each major type of new works constructed, and for the cost of all new works. A descriptive entry was required for types of new works not listed. An inquiry on location of the outlet of the new drainage works helped to identify and locate the lands of the project.

Section III contained inquiries related to the area in the project, starting with the area in 1950. For projects included in the 1950 Census, the 1950 area was posted prior to the enumeration. This was followed by an inquiry on the area added since January 1, 1950, and on the area in 1960. This section also included inquiries to determine if any extensive portion of the land in the project area received no drainage benefits or was not being used for agriculture.

Section IV obtained information regarding areas overlapped by other projects. A distinction was made between land provided separate or supplemental service and land taken over by or from another project.

In Section V, provision was made for listing the name of the person, or persons, who supplied the information and the certification of the filled questionnaire by the enumerator and his supervisor.

Shaded squares on the questionnaire gave notice to the enumerator that additional information was required in respect to the project. Shaded squares opposite the area data indicated that

the location and approximate boundaries of these areas must be entered and identified on a map. When this additional work of enumeration was completed, an "X" was to be entered in the shaded square. A shaded square below the inquiry calling for a listing of the other counties involved in an intercounty project served as a reminder that the portion of each of these other counties must be enumerated also.

The questionnaire carried worksheets on the reverse side to facilitate the summarization of drainage activities for the 10-year period and for obtaining a breakdown by counties of data for intercounty projects. A township outline map, also on the back of the questionnaire, provided a place for sketching the location and approximate boundaries of the area served.

Preparation of a drainage map.—In addition to a filled questionnaire, the enumeration of a drainage project required the locating of each project on a map and the outlining of the approximate boundaries of the area served. For projects included in the 1950 Census, the enumerator was furnished a county map on which the location and approximate boundaries of these projects had been entered in the 1950 Census. Thus, the 1960 enumerator generally needed only to map projects not included in the 1950 Census and show changes in areas represented by projects already mapped. Of course, if he found the 1950 mapping to be in error he was expected to correct it. If desired, a separate map or tracing could be submitted, or a sketch drawn on the back of the questionnaire.

Mail canvass.—The listing of drainage projects by the Soil Conservation Service indicated that for 8 of the 48 conterminous States for which no drainage projects were found in the preceding drainage censuses, no drainage undertakings benefiting 500 or more acres of agricultural land had been undertaken during the 10-year period since 1950. Consequently, no further canvass was needed in these 8 States. These States were the New England States, Pennsylvania, and West Virginia.

In Alabama, Georgia, New Jersey, and New York, there were so few projects that a field canvass was not justified, from the standpoint of economy. A similar situation prevailed for Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming where the need for much of the drainage had developed because of irrigation and the projects would not qualify for inclusion in the 1960 Census. The enumeration in these 12 States was conducted wholly by mail.

In the remaining States, a mail canvass was used for most of the counties for which there were less than 5 known drainage projects to be enumerated. Exceptions were made mostly for (1) "county-drain" States where several drains under the same management might be included in one report, (2) those instances where an enumerator would need to go into the county to complete the enumeration of intercounty projects, and (3) counties that involved a minimum of additional time and travel on the part of an enumerator assigned to an adjacent county. In several instances, enumerators were used to complete the enumeration initiated by mail canvass.

Of 1,336 counties requiring reports, 271 were completed by mail canvass and 1,065 by field enumeration. Of the 1,065 counties completed by field enumeration, the initial canvass in 34 counties was by mail, and in 61 other counties a part of the enumeration was by mail canvass. The 979 projects included in the mail canvass required 2,034 mailings, with the enumeration completed for 870 projects and with 109 projects assigned to enumerators for completion.

A facsimile of the letter used to accompany the mailed questionnaire is included in the appendix.

A mail followup was used to complete the enumeration in instances where the enumerator failed to obtain all the necessary information and the lacking information could not be estimated satisfactorily.

The local offices of the Soil Conservation Service provided assistance in numerous instances where there was difficulty in obtaining a satisfactory address or where the necessary information was incomplete. Projects for which assistance was asked were those for which the Soil Conservation Service had provided technical assistance, or legal organizations for which the information could be obtained readily from public records. Many of the legally organized projects, for which information was needed, had been inactive for years, or dissolved with no present management or organization. Dependence was placed, to a large extent, on the Soil Conservation Service for information for inactive or dissolved drainage projects for which no person who was ever associated with the organization could be found.

Field enumeration.—Enumerators for the Census of Drainage were selected from crew leaders and, in a few instances, from enumerators employed in the general 1959 Census of Agriculture. For the 1960 Census of Drainage, 156 enumerators and 21 supervisors were employed. The enumerator assignments averaged about 4½ weeks in duration.

The enumerators and supervisors were trained simultaneously at 10 training locations, selected to provide a minimum of combined travel. The training consisted of two days of technical instruction covering all phases of the enumeration with emphasis on problem situations that could be expected.

The unit of assignment was a county, with each enumerator generally assigned several counties. A drainage enumerator was paid \$1.95 for each authorized hour worked. He was allowed 7 cents per mile for the use of his automobile on official travel, and \$12.00 per diem for living expenses when overnight stops away from home were required.

There was no routine procedure for finding the information needed for the enumeration. The enumeration might require interviews with various individuals and public officials directly connected with specific drainage organizations, or who, because of their public office, might have knowledge of drainage undertakings in the area or records pertaining to such undertakings, or of the present condition and use of lands represented by projects mapped in the 1950 Census. The enumeration of a particular project often required interviews with several individuals and the examination of various public records and maps. Records pertaining to legally organized drainage projects were generally found among the county court records. Sometimes, records were in the hands of town or township officials, or with officials of the drainage organization. At times they were fragmentary. In a few cases records were nonexistent. The records were seldom in such form that the desired information could be taken off directly. When recorded information for an item was not available, the enumerator was instructed to obtain an estimate from a reliable respondent.

Of the 8,485 drainage projects for which data were tabulated in the 1960 Census, 2,348 were inactive throughout the 10-year period 1950-59. For many of these projects, the enumerator could find no person connected with the organization to furnish information regarding the project. In some instances, projects had been inactive over such a long period of time that few individuals could be found who knew that the project had ever existed. In other cases, the enumeration could be accomplished only through inquiry of local officials or affected landowners as to whether the area shown for the project in the 1950 enumeration included any extensive areas which were no longer receiving drainage benefits or were not being used for agriculture.

Completed counties.—As the enumeration of each county was completed, the enumerator turned over to his supervisor all enumerative materials for the county. The supervisor was required to review these materials, following an outline of checks provided for this purpose. After reviewing the materials for each county, the supervisor forwarded them to Washington for processing.

OFFICE PROCESSING

Editing.—Upon receipt in Washington, the drainage questionnaires and maps were examined for completeness and consistency in preparation for tabulation of the data and the reproduction of the maps. A check was made to see that all material for each county had been received including a filled questionnaire for each project. The list of projects that had been furnished prior to enumeration was reviewed for coverage. Omitted items of information were supplied, when available from records in the Bureau, or the figures could be estimated with reasonable accuracy. Inconsistencies between the areas stated in the reports and those mapped were reconciled, insofar as possible, on the basis of the information available. When the available information was insufficient to supply missing data, or to reconcile discrepancies, the needed additional information was obtained through correspondence.

For each intercounty project, the reports were checked to ascertain that complete and separate information was shown for each county part without duplication.

Questionnaires representing undertakings or organizations not qualifying for inclusion in the 1960 Census, as well as those representing duplications, were "rejected." In preparing the advance listing of drainage projects, the names of those for which there was insufficient information to determine whether they would meet the 1960 criteria were purposefully included. The enumerator did not make the decision whether a questionnaire should be filled for such projects. On the contrary, he was required to fill a questionnaire, thus providing documentary evidence as to why the project did not qualify. (For 1960 criteria, see "Definitions and Explanations.") Of 11,483 questionnaires returned in the enumeration, 2,072 were later rejected as not qualifying or because of duplication, and 113 were for projects which had been superseded by other projects during the 10-year period, 1950-1959.

All separate materials, including correspondence, sketch maps, etc.; the worksheets on the reverse of the questionnaire; and notations entered under "Remarks" or elsewhere on the enumerative materials, were examined for information that might be of assistance in the editing.

To check the mapping, the plat for each drainage project was identified on the county map. If a separate map, sketch, or tracing of a project was furnished, it was checked against the county map. If not already plotted, the project was entered on the county map; if in error, the plotting on the county map was corrected. The location, as shown on the map, was checked against any information as to location given on the questionnaire or other materials such as the name of the project, the location of the outlet, overlapping projects, land descriptions, and the like. The extent of the mapped area for each project was checked visually to see that it was reasonably consistent with the area reported on the questionnaire. Areas omitted from the questionnaire were obtained by planimeter measurement of the mapped areas. If the mapped and reported areas differed substantially, available information in the Bureau, including materials for the project from earlier censuses, were generally sufficient for making the necessary correction.

If extensive nondrained or nonagricultural areas were indicated on the questionnaire, but were not identified on the map, such areas could generally be identified by use of materials available in the Bureau such as aerial photographs and detailed maps showing current cultural and physical information. Likewise, if it was evident that an enumerator had omitted to indicate any extensive nonagricultural areas located within drainage projects, such as cities, airports, recreation areas, parks, military installations, wildlife refuges, State or National Forests, or commercial

woodlands, the nonagricultural portions were determined on the basis of these materials.

In checking the county map to the questionnaires, careful consideration was given to the delineation of overlapped areas. Often the extent of supersedence of a project by another, or the quantitative determination of areas served by two or more projects, could be determined only by careful plotting of the overlapping projects. In counties with extensive overlapping, the determination of the net area of land benefited by all projects generally, of necessity, had to be based almost entirely on the mapped areas. In fact, for most counties in the "county-drain" States, the net area serviced by county drains could be obtained only by plotting the separate drains, then measuring the overall mapped area. This had been the procedure for the "county-drain" States in 1950; therefore, only additions and deletions had to be considered in 1960.

After reconciling the questionnaires and the mapped areas, a determination of the area served in 1960, excluding any extensive areas not receiving drainage benefits from works of the project or not used for agriculture, was made for each project. The area served by a project included lands served jointly by it and other projects. Any portion of the project which had been taken over by some other project, however, was excluded. The 1960 area in individual drainage projects was used to tabulate the area of drainage projects by size of project, by type of organization, and by year of organization. That portion, if any, of the 1960 area which was provided separate or supplemental drainage service by one or more other drainage projects was also determined.

To obtain net acreage figures for land in drainage projects, counting only once the land in each project, a worksheet was prepared for each county. (A facsimile of this worksheet is included in the appendix.) Since the 1960 enumeration utilized 1950 Census information as a starting point for both the filling of a questionnaire and for performing the required map work, the worksheet also started with the 1950 information. The worksheet provided for posting (1) changes from the data reported in 1950, (2) areas of extensive nonbenefited or nonagricultural lands within drainage projects, and (3) areas served by two or more projects. For each of these categories, each tract of land was to be entered only once. In recording changes in areas since 1950, a distinction was made between lands for which drainage was established before 1950 and areas added in the 1950-1959 period.

To insure reasonable accuracy in the areas mapped, the net totals obtained from the worksheet were checked to planimeter measurements of the mapped areas in the county. A similar check against planimeter measurements had been made in 1950. If there were no substantial changes since 1950, no remeasurement was made for 1960.

Tabulation of data.—The county worksheets prepared in conjunction with the editing were used as a source for posting the total area in drainage projects, counting only once land served by two or more projects. This net area represented the land classified (1) on the basis of agricultural use, (2) by year when drainage was established, and (3) by number of projects providing drainage service. All other data were tabulated by adding the items as determined for each individual project.

Preparation of maps.—After reconciling the maps and questionnaires, a tracing was made of each county map outlining the overall areas in drainage projects, exclusive of any designated nondrained or nonagricultural portions and projects not qualifying under the 1960 criteria. These tracings of individual counties were then used for the preparation of the individual State and the United States drainage maps.

DEFINITIONS AND EXPLANATIONS

General.—Although the definitions and explanations which follow refer specifically to the 1960 Census of Drainage, many of them also apply to earlier censuses. Items for which the 1960 definitions and explanations are not adequate for earlier years are discussed further under "Comparability of data." Most of the definitions consist of a résumé of the questionnaire wording, supplemented by excerpts from instructions given to enumerators.

Drainage of agricultural lands, from the standpoint of adequacy, can represent varying degrees of improvement. Therefore, the term "drainage" is not subject to a precise definition. It can be defined only in general terms, subject to considerable variation in application by individual respondents and enumerators. In most instances, however, the resulting data have reasonable overall accuracy and usefulness. It should be kept in mind that in individual instances, had the information been obtained from other respondents or by other enumerators, the results could have been somewhat different. This situation helps to explain some of the differences in the results obtained in the different censuses. (See discussion of "Comparability of data.") There are many geographic areas for which the totals shown in 1960 for land with drains established before 1950 differ from the total areas in drainage projects as reported in the 1950 Census by amounts greater than can be explained by changes in definition.

The use in the 1960 enumeration of areas drained and mapped lands as obtained in the 1950 Census, undoubtedly, had some influence on the data tabulated for 1960 and for the mapped areas shown for 1960. A disadvantage of this procedure was the possible acceptance of the 1950 information in instances where more reliable data could have been obtained. The 1960 enumerator, however, was instructed to correct any errors found in the 1950 enumeration. It is likely, therefore, that the undetected errors were fewer than would have resulted in an enumeration that did not make use of information collected previously. On the whole, this practice probably did not influence the 1960 data appreciably.

Drainage.—The term "drainage" as used in this volume refers to agricultural drainage. Drainage is the removal, by artificial means, of excess water to improve the condition of the land for agricultural use. Drainage is accomplished by means of constructed works and may represent deepening, widening, or straightening of a natural channel; the construction of open ditches; the installation of underground tile or conduits; the construction of drainage wells; the installation of pumps for removal of water; or a combination of these methods, including associated works such as dikes or levees, floodgates, bridges and culverts, land leveling, and removal of snags, brush, or other obstructions which impede water flow.

Storm sewers, sanitary drains, highway ditches, and drains for industrial sites were not considered drainage works, for purposes of the census, unless they also accomplished improvement of agricultural lands.

The mere protection of land from flood waters or from surface runoff, with no drainage works provided to remove gravitational soil water from the protected lands, was not considered as drainage. Flood control works may involve (1) channel construction or improvement, (2) the inclusion of floodgates and outlet drains through the constructed levees so as not to impair natural drainage or drainage previously established, or (3) work on levees or ditches associated with drainage. As a consequence, it was sometimes difficult to distinguish between works serving for flood control only and those providing drainage benefits. Thus, some flood control projects of the U.S. Corps of Army Engineers, or portions thereof, were considered as providing drainage services and included in the 1960 Census. Examples include several channel improvements in the Delta and other

alluvial areas in the Mississippi River basin. These, generally, had been listed by the Soil Conservation Service as projects undertaken since 1950 that provided drainage benefits to 500 or more acres of agricultural land. Another example of borderline projects included were those for which construction or enlargement of levees was accomplished by the U.S. Corps of Army Engineers, but for which future maintenance was the responsibility of drainage districts.

Drainage works constructed solely for the removal of irrigation seepage water or for removal of alkali from the irrigated lands were excluded for the purposes of the 1960 Census. Similarly, when a drainage well or ditch served primarily as a source of irrigation water, with drainage no longer a problem, such projects were not to be included. Drainage established because of irrigation, generally, is so tied in with the irrigation works that it should be considered a part of the irrigation works and system rather than drainage. (See "Scope of the 1960 Census of Drainage.") Drainage operations benefiting naturally wetlands were to be included in the 1960 enumeration, even though such lands were also provided with irrigation. As with drainage coupled with flood control, there was evidence of lack of uniformity in determining when drainage of irrigated lands qualified for inclusion. In a few instances, conflicting information was obtained from different respondents for the same project.

Drainage project.—A drainage project is a plan undertaken as a unit to provide new construction, or to provide maintenance and operation of existing drainage works. A drainage project represents an undertaking under one control, supervision, or guidance.

A drainage project may be undertaken by a single landowner. Often, a farmowner cannot accomplish optimum drainage of his land, acting alone. Obtaining an outlet for his ditches may involve crossing some other owner's land. As a consequence, much of the drainage in the United States has been accomplished as community undertakings, participated in by landowners who have common drainage interests. The administrative structure set up to provide unified action for handling the drainage problem is referred to as its organization. All drainage activities under the direct supervision of one organization or management comprise one project. A drainage project may refer to an accomplished plan, i.e., the physical works have been provided and no further work or maintenance is anticipated on the part of the original organization.

For the 1960 Census, all drains constructed and/or operated by one organization were considered as one project even though they were noncontiguous and were constructed at various times. For example, all public drains under the administration of county officials, or under a special board set up to administer public drains in the county, are treated herein as one project. (See discussion of "County-drain" States.) Similarly, drainage subdistricts administered by the officials of the parent district were generally included with the parent district.

When identified, all drains, formerly but no longer under county jurisdiction and with no present organization responsible for their maintenance, were grouped together and included in one separate report. Such drainage "district" may have been discontinued through petition of the landowners or other legal action, or may no longer be considered as under county jurisdiction because of years of inactivity. The instructions to enumerators did not ask specifically for the identification of county drains that had been withdrawn from the county system. The enumeration instructions specified that for most counties in "county-drain" States, the net area had been satisfactorily determined and mapped in 1950 and, therefore, it would be necessary only to determine the area brought in by new drainage works since 1950. Thus, occasionally a 1960 report for county drains may have included some drains not identified as not being under county management in 1960.

For Delaware, which had been enumerated as a "county-drain" State in 1950, even though the predominant form of drainage organization was the drainage district (see discussion of "County-drain" and "Drainage-district" States), a similar procedure was followed even though each of the inactive drains, arbitrarily combined in the one report in 1960, had originally had its own separate organization. The extensive overlapping and super-sequence, which had occurred through years of drainage activity in the State and which had led to the use of a county questionnaire in 1950, was responsible for similar treatment of all inactive drains in 1960.

Only projects providing drainage benefits to 500 or more acres of agricultural land as of January 1, 1960, were included in the 1960 Census. (See definition of "Drainage.") Enumerators were instructed to consider as agricultural land all woodland and wasteland within farms. They were instructed *not* to consider as agricultural land any areas, used solely for the production of wood or timber, which were not a part of a farm.

A project need not provide complete drainage for the area served. Many projects, especially public drains, provided only the principal channel or outlet drain. The construction of the laterals and field drains, which were required to provide complete drainage of the land, may have been left to the individual farm owners. These supplemental drains, though providing drainage to the same area and necessary for the complete drainage system, were not included with the project for which they furnished supplemental works, but each was considered a separate project, and was separately enumerated if benefiting 500 or more acres.

For projects for which works had been taken over by another project (see "Superseded projects."), any portion not taken over was considered a separate project. If the entire project had been taken over, or if the portion not taken over was less than 500 acres, the project was excluded from the census.

The term "project," for describing the unit for enumeration in the 1960 Census, was usually used in preference to "enterprise" or "organization." "Project" more nearly indicates the physical works represented. "Enterprise" or "organization" refers more to the management and implies reference to all activities of the management which may include functions other than drainage. Furthermore, "organization" implies current active management of a group undertaking. The 1960 Census also included projects for which there was no longer an organization in addition to projects having a definite organization, and projects established by individual owners and cooperative groups without formal organization.

Intercounty projects.—For drainage projects extending into two or more counties, a separate report was obtained for the portion in each county. In presenting data by counties the portion in each county was treated as a separate project, but in presenting data by States the entire project was considered as a unit. Thus, the count of projects shown by counties in County Table 1 will not add to the count shown for the State. Differences in the "county count" and in the "State count" are shown in Summary Table 6. In the 1960 Census, 727 intercounty projects were reported with 1,564 county portions. Of these intercounty projects, 643 included land in two counties; 77, in three counties; 3, in four counties; 2, in five counties; 1, in seven counties; and 1, in eighteen counties.

For intercounty projects, the determination of whether the project qualified, from the standpoint of acreage, for inclusion in the 1960 Census was based on the entire project. For that reason, some county parts, treated as separate projects in the presentation of data by counties, represented fewer than 500 acres of drained agricultural lands.

If separate records of the drainage activities for each county part were not available for an intercounty project, the enumerator

was instructed to allocate on an area basis, or other equitable basis, the portion applicable to each county.

For intercounty drains represented in county-drain systems, the enumeration instructions required that the portion in each county be included in one report covering all county drains in the county. This procedure was to be followed irrespective of whether each county part was administered separately, or whether the entire project was administered wholly by one of the counties or jointly by the counties affected. (See "Drainage projects by size.")

Superseded project.—Many drainage organizations were established for a specific purpose such as to construct new drainage facilities, or to renovate or enlarge facilities established by an earlier organization. Upon accomplishment of its immediate objective, the organization often became inactive or was dissolved. When further work was needed, a new organization was established. The new project may have included the same land, more acreage, or less acreage. Over the years there has been extensive overlapping of drainage projects, only a portion of which may now have an active organization. (See "History of the Census of Drainage.")

Projects wholly superseded prior to 1950 were generally excluded from the 1960 enumeration. Those wholly superseded between 1950 and 1960 were always excluded from the 1960 count of drainage projects. If, however, a superseded project reported drainage operations during the decade, 1950-1959, such operations were included in the data presented for drainage operations, 1950-1959. (See Summary Table 6.) Occasionally, this resulted in a greater number of projects reporting operations during 1950-1959 than the total number of projects in 1960.

Control of a project may pass from one organization to another through court action. More often, change in control has occurred when an organization originally responsible for the construction and the maintenance merely ceased to actively operate the drainage works or to provide maintenance, and these functions were assumed by a new organization or management; or the old works were replaced or incorporated in the works of a new organization.

Whenever the area of a project with no active organization was overlapped by one with active organization, or by one more recently organized if neither project had active organization, the editing procedure required that the overlapped area be considered as having been taken over by the active or more recent organization. Projects of less than 500 acres and, therefore, not included in the Census, were never considered as having taken over works of another project.

Area in drainage projects.—The area in a drainage project is usually the area benefited by the drainage works. For a project undertaken by landowners, either individually or cooperatively, it is the area improved or benefited for agriculture as a result of the drainage facilities provided. For a legally organized drainage project, the area in the drainage project is the area established by the decree setting up the drainage district or project. If public drains are administered on a countywide basis, or on the basis of established political boundaries, it is the area directly benefited by the drainage works. In special districts organized primarily for purposes other than drainage, it is the entire area in the district even though only part may be benefited by the drainage works.

The area served by two or more projects was included in each project. The area taken over by one project from another was included in only one, usually the later project. (See discussion of "Superseded projects.")

Since the area of a legally organized project is that established by the court or other authority, it has definable boundaries. If special taxes were collected for the drainage, the area taxed can be considered as the area in the project. The 1930 Census made a distinction between total area and area assessed but the difference amounted to less than one-third of one percent. Changes in

area of a legally organized project may occur because of addition or deletion of land through action of the court or other authority responsible for the organization. Within the boundaries of a project there may be tracts that receive no drainage benefits or land not assessed. Such excluded areas may or may not have been shown in the mapping. This may account for some of the differences between reported and plotted areas.

Generally, the area in a public or legally organized drainage project represents the area benefited. In some instances, however, land liable as security for bonds or other obligations of a drainage organization may include some high or ridge lands with adequate natural drainage, or some wetlands not reclaimable. Also, the project area may include some benefited land not utilized for agriculture. The 1960 enumeration provided for the determination of any contiguous areas, totaling 500 or more acres, not used for agriculture or not benefited by the drainage works. (See "Area not used for agriculture or not drained.")

For organizations providing a major public service other than drainage, the area may include the entire district although the drainage service provided may benefit only a portion of it.

For projects owned by one landowner and projects representing drainage undertakings of two or more landowners cooperating without organization under statute law, the determination of the area was less precise and represented the judgment of the respondent as to the area improved or benefited. The area was often estimated by the Soil Conservation Service in the case of projects for which they provided technical assistance.

The presentation of the 1960 data includes several items relating to area in drainage projects for which a special explanation is considered necessary.

1. *Total area in drainage projects*, as presented in line 5 of County Table 1, line 4 of State Table 1, and Summary Tables 1 and 5, and *Land in drainage projects* as presented in column 1 of Summary Table 7 represents the total area of land, within the specified geographic unit, that was in drainage projects included in the 1960 Census. Land in two or more drainage projects was counted only once. This item includes some land not used for agriculture and some land not drained. (See "Area not used for agriculture or not drained.")

2. *Net area drained and used for agriculture*, as presented in line 8 of County Table 1, line 6 of State Table 1, and Summary Tables 1 and 5, and *Land in drainage projects* as presented in column 1 of Summary Tables 8 and 13, excluded extensive contiguous areas of land not used for agriculture and land not drained. (See "Area not used for agriculture or not drained.") Land in two or more projects is counted only once.

3. *Totals of areas of individual projects*, as presented in line 10 of Summary Tables 1 and 5, column 15 of Summary Table 8, and the area data for drainage projects classified by size of project, by type of organization, and by year started or organized (County Table 1, State Tables 1 through 4, and Summary Tables 1 through 5, and 11, 12, and 13) represent the sum of the areas in individual projects with no deduction for land included in two or more projects. Extensive contiguous areas of land not used for agriculture and land not drained were excluded from this item. (See "Area not used for agriculture or not drained.") The difference between this item and the preceding item is due to land served by two or more projects. (See "Area served by two or more projects.")

Area not used for agriculture or not drained.—The area in drainage projects frequently included land that was not being used for agriculture or land that was not receiving drainage benefits from works installed or operated by the project. (See definition of "Area in drainage projects.") Two questions (16 and 17) on the 1960 Drainage Questionnaire identified contiguous tracts of 500 or more acres of such land within the area reported for the project. The area not benefited might represent land for which the drainage works had completely deteriorated or land for which no drains had been provided. For a project which provided both drainage and flood protection, the questionnaires identified, for exclusion, any land protected from overflow with no drains provided. Land with drainage required solely because of irrigation was, likewise, identified and excluded.

Land within drainage project boundaries not used for agriculture might be wasteland, cutover land, residential or industrial areas, airports, military installations, public parks, wildlife refuges, State or National Forests, commercial woodland, or other lands in nonagricultural use.

Inquiries which served to identify areas of nonagricultural or nonbenefited lands within drainage projects could not be utilized advantageously to locate all such lands. For that reason, the effort was restricted to the determination of contiguous areas of 500 or more acres. In the application of this requirement, small scattered tracts of benefited agricultural lands, in extensive areas predominantly nondrained or nonbenefited, were sometimes disregarded in the enumeration or in the office processing. Enumerators, also, occasionally failed to report areas, such as towns, airports, public parks, wastelands, etc., which obviously were nonagricultural or nonbenefited. This omission may have been due to misunderstanding as to the nature of the information available for the project from the 1950 Census. Information for lands not used for agriculture or not benefited was not obtained in 1950. The 1960 instructions had stressed the need for obtaining changes in operations since 1950. With no change in the situation, the enumerator may not have been aware of the need for this information. Whenever an omission was indicated, the nonagricultural or nonbenefited areas were determined through correspondence or from examination of maps and aerial photographs available in the Bureau.

The item identified in the tables as "Net area drained and used for agriculture" was obtained by subtracting, from the total area in drainage projects, only the included tracts of 500 or more contiguous acres reported as not used for agriculture or not drained. Thus, the area shown as drained and used for agriculture may include many acres of interspersed nonagricultural or nondrained lands in tracts of less than 500 contiguous acres. This explains why the "Net area drained and used for agriculture" reported for a county sometimes exceeds the total land area in farms.

In the tables showing the total areas of individual projects classified by size, type of organization, and year started or organized, any contiguous tracts of 500 or more acres identified as being nonagricultural or nondrained were excluded. If the total area served by an individual project, exclusive of such nonagricultural or nonbenefited lands, was less than 500 acres the project was "rejected" and excluded from the 1960 totals. For intercounty projects the determination was based on the entire area, and not on the portion in each county.

The exclusion of nonbenefited portions, in the presentation of area data for projects classified by size, by type of organization, and by year started or organized, resulted in the data for one Florida county showing one project with no acres. A major project reported for Florida extended into 18 counties several of which were reported as receiving no drainage benefits as of January 1, 1960, from works constructed or operated by the project. Much of the work done prior to the census date represented planning and engineering. Completed construction and costs for operation of drainage works were limited, as of January 1, 1960, to 9 of the 18 counties.

Land by year drainage was established.—The area drained and used for agriculture was classified, on the basis of when the drainage was established, into two groups, as follows: (1) *Drainage established before 1950* and (2) *area added 1950–1959*. If a project took over the works of another, or provided supplemental service to an area included in an earlier project, the land was usually classified on the basis of the drainage established by the earlier project. Thus, land reported as in drainage projects in the 1950 Census was, with few exceptions, classed as provided with drainage prior to 1950. Generally, for drainage projects reported as organized or started prior to 1950, all the land reported as in the project on January 1, 1950 (question 13 on the questionnaire) was classed as having drainage established before

1950. Land reported as added since January 1, 1950 (question 14 on the questionnaire) was considered as land with drainage established since 1950, provided new works were reported and the added area did not represent an overlapping of area included in the 1950 area of some other project. Additions to a project, which had been made because the lands were already receiving drainage benefits, were not considered as "area added 1950-1959."

For a project started in 1950 or later, the entire area, except for any portion overlapping an older project, was classed as having drainage established in the 1950-1959 period. Usually, the determination of drainage established for new areas was supported by reports of newly constructed drainage works. In a few instances, the drainage works reported for the newly drained lands consisted entirely of cleanout or restoration of old works. If the land had not been included in the 1950 Census, or in another project reported in 1960, the area was classed as having had its drainage established in the 1950-1959 period, on the assumption that the old works requiring renovation had ceased to provide the area with drainage benefits.

The assessed or taxed area of a project sometimes included land for which the drainage had not been established. In the case of an organization providing a public service, other than drainage, only a portion of the area of the project may have been receiving drainage benefits. For this reason, there were some instances where the 1950 area of a project included land for which drainage was actually first established since 1950.

Land classified on the basis of when drainage was established should not be confused with land reported for drainage projects classified on the basis of when the project or organization was started. (See Summary Table 13 and discussion of "Drainage projects by year started or organized.")

Area served by two or more projects.—The area served by two or more projects was obtained (1) through the questionnaire inquiries on overlapped area (Section IV of the questionnaire) and (2) by checking the mapped boundaries of each project. Careful determination of the overlapped areas was essential to the determination of the net land benefited by drainage projects and, for that reason, received special consideration in the editing process. A distinction was made between areas taken over and areas provided separate or supplemental service.

Usually, separate or supplemental service was the result of one project providing the outlet drainage facilities and another the laterals or branch drains. Or, each may have provided certain specified drainage works or services. Sometimes three or more projects provided service to the same area. As a general rule, the editing instructions considered that overlapped areas, as determined from the mapping of the lands in each project, represented dual service except when it was determined that one project had taken over the lands of another.

In making the determination of the area served by two or more projects, consideration was given to possible errors in mapping. If the plotted areas of two projects indicated overlapping, but the net area mapped for the two projects was equal to the sum of the areas reported for each without any deduction for overlap, the projects were considered as not having any area in common. A similar determination was made for adjoining projects when one did not provide an outlet for the other. The apparent overlap may have been indicated solely because the source materials for mapping did not reflect all revisions in the boundaries of each of the two projects.

In presenting the portion of the net land area in drainage projects represented by tracts served by two or more projects (line 11 of County Table 1, line 9 of State Table 1, and Summary Tables 1 and 5, and columns 7-10 of Summary Table 8), each tract served by two or more projects was counted only once. In presenting the portion of the totals of areas of individual projects provided with service by one or more other projects (column 3

of State Tables 2, 3, and 4; also column 3 of Summary Tables 2, 3, and 4) each tract receiving service from two or more projects was included for each of the projects. The differences in the totals shown for these two items were the result of the multiple counting, in the latter, of land served by two or more projects. Lands served by two projects were included in each of the two projects; lands served by three projects, in each of the three; etc. The total net area drained and used for agriculture, likewise, does not contain any duplication of land served by two or more projects but the totals of the areas of individual projects include multiple counting of the land included in more than one project.

Approximate land area.—The approximate land area comprises land in farms, cities, forests, swamps, deserts, etc., and the area occupied by streams, sloughs, estuaries, and canals less than one-eighth of a mile in width, and lakes, reservoirs, and ponds of less than 40 acres. Changes since 1940 reflect political changes in boundaries or actual changes in land area caused by changes in number and size of reservoirs, lakes, etc. The figures for 1940 represent a complete redetermination of the area and may differ from those shown for earlier years.

Land in farms.—The acreage designated under "Land in farms" was obtained in the census of agriculture. The "land in farms" figures, shown in the tables presenting data for the 1960 Census of Drainage, are from the 1959 Census of Agriculture taken in the fall of that year. "Land in farms" consists primarily of lands used for agriculture, but also includes considerable areas not actually under cultivation nor used for pasture or grazing. All woodlands and wastelands owned or rented by farm operators were included unless being held for nonagricultural purposes or unless the acreage was unusually large.

Drainage operations, 1950-1959.—For each project included in the 1960 Census, information was obtained for drainage activities for the 10-year period, 1950 to 1959, inclusive. The 10-year period could be on either a calendar- or fiscal-year basis. In either case a report was intended to include a full 10-year period. For convenience, a worksheet was provided for entering data for each of the 10 years.

Reports on drainage works and services during this 10-year period were required for all projects which, at any time during the period, provided drainage benefits to 500 or more acres which were being used for agriculture in 1960. The data for drainage works and services, therefore, include totals for some projects which had been taken over by another project prior to 1960.

When a project provided a major public service in addition to drainage, the enumerator was instructed to include with the drainage works ditches, pumps, or other works, or portions thereof, that accomplished drainage of agricultural lands even though these served primarily as storm sewers, sanitary drains, highway ditches, or for the drainage of residential or industrial sites, or for irrigation, or for some other special purpose. If no separate records were kept, costs and works were to be allocated to provide an equitable share to agricultural drainage. If the allocation was not made in the field enumeration, the allocation was made during office processing, unless the amounts involved were exceptionally large. In the latter case, the information was obtained through correspondence.

Cost of all drainage works and services.—The inquiry called for the total cost of all drainage works and services provided for the 10-year period, 1950-1959. The total was to include costs for all drainage activities of the organization, including construction or installation of new drainage works, enlargement or complete replacement of prior works, cleanout or restoration of old works, maintenance, operation, or repair of drainage works, and administration. The questionnaire required the inclusion of all costs relating to the works and services provided, regardless of when paid or to be paid. Specific mention was made of costs of organization, engineering, rights-of-way, legal services, and administration. Payments on principal or interest on bonds or notes were

not to be included. The enumeration instructions asked for the inclusion of all costs for physical works, materials, equipment, etc., regardless of the source of the funds used. Costs paid by a county, a State, or the United States Government, or by another drainage organization for use of facilities provided by the reporting organization were to be included.

New drainage works constructed, enlarged, or installed.—New drainage works referred to the digging or placement of drains where none existed before; the straightening, enlarging, widening, deepening, or relocation of natural channels or of prior ditches; or the installation or replacement of drainage pumps. The original construction of levees or dikes for the protection of lands provided with drainage, or their extension or enlargement, was, likewise, considered as new drainage construction. Maintenance, cleanout, or restoration of prior works, with no enlargement or change in the original works, were not considered new drainage construction.

The enumerators experienced some difficulty in determining when work on old drains was to be considered as new works.

For each of the three principal types of drainage works—*open ditches, tile or covered drains, and levees or dikes*—information was obtained as to the length of new construction; and for *pumps*, the number of newly installed pumps. New works represented by other structures such as drainage wells, sumps, flood or tide gates, bridges, culverts, wellhouses, and land leveling were to be reported under “*other*.” No information was obtained for these “*other*” new drainage works except their type. The data presented include only a count of the projects reporting “*other*” new works.

Costs of new works.—This part of the overall cost for drainage was obtained in a separate question by asking how much of the total cost of works and services represented the cost of new drainage works reported.

Cost of maintenance, operation, repair, and administration.—This was obtained by subtracting the costs of new works from the total costs reported for all drainage works and services.

Drainage projects by size.—Drainage projects were classified on the basis of the total acres of agricultural land receiving drainage benefits from works of the project. In the classification by size of project, the portion in two or more projects was included in each project. For intercounty projects, the determination of size was based on the total acres in the project, not on each county portion.

For a project comprising all drains under the jurisdiction of a given county, the area represented the combined total of the individual areas of drained land in the county that were administered by county officials, including portions of intercounty drains administered by other counties. Although projects with fewer than 500 total acres were excluded from the 1960 Census, the crediting of each portion of a county drain to the county in which located resulted in reports for county drains for two counties in 1960 showing less than 500 acres of drained agricultural lands. These two counties were Benton, Iowa, and Jerauld, South Dakota. In 1950, there were three such “county-drain” reports, the two counties mentioned above and Fulton, Kentucky.

For Delaware, all drainage projects for which there was no active organization at the time of the census were grouped into a single report for each county. This arbitrary procedure affected the data presented by size of project.

Drainage projects by type of organization.—Drainage projects were classed by type of organization into three groups:

1. **Drains owned by one landowner**—A landowner may be an individual, a partnership, an estate, a private corporation, or an institution.
2. **Cooperative or mutual drains** represent undertakings by two or more landowners cooperating without special organization under State drainage laws for the construction or operation of drainage works benefiting their lands. Many of the

cooperative or group drainage projects were undertaken under the guidance of the Soil Conservation Service.

3. **Legally organized public drains** represent community or public drainage undertakings accomplished through some form of governmental organization. These could be an organization administered by public officials of a county, a township, a State, an agency of the Federal government, or by specially elected or appointed officials or boards. A large variety of general or special State laws provide for equitable cooperation among landowners who will be benefited by a drainage undertaking. (A synopsis of drainage laws in the various States was included in the 1940 Census of Drainage report.)

Although legally organized drainage projects represent a large variety of types, most fall into two major groups. (1) County drains are governed by county officials or by a special official or board elected or appointed to administer public drainage undertakings in the county. In the 1960 Census all county drains in a county were treated as though they represented one project. (See “Drainage project,” “Intercounty projects,” and “County-drain” States.) (2) Drainage districts are governed by a special official or board elected or appointed for that particular project. (See “Drainage-district” States.)

Drainage projects by year started or organized.—The classification of projects by the year in which they were started or organized provides an indication of relative drainage activity in different periods of time. The drainage activity may not necessarily have represented construction of new works or the establishment of drainage on lands not previously benefited. Frequently the purpose of a new drainage project or organization was the restoration or improvement of existing drainage facilities, their extension, or the construction of supplemental works.

The classification of a project by year the project was started or organized should not be confused with the classification of the land by the year in which drainage was established. (See “Land by year drainage was established.”) A project started or organized prior to 1950 may include some lands for which drainage was first established since 1950 while a project started or organized since 1950 may include lands on which drainage had been established by a prior project. State Table 4 and Summary Table 4 provide data on land by the year drainage was established for projects started or organized before 1950, and those started or organized in the period 1950–1959, respectively.

COMPARABILITY OF DATA

Continuity maintained despite changes.—The scope and content of the Census of Drainage has varied considerably since the first Census of Drainage in 1920. Notwithstanding the variation, a reasonable degree of continuity has been maintained in the data collected and tabulated. In 1920, 1930, and 1940, emphasis was placed on the status of drainage facilities as of the census date while in 1950 and 1960, emphasis was placed on the drainage activities for the most recent 10-year period.

Changes in enumerative procedures.—The Census of Drainage has always been primarily a census of community or public drainage undertakings and of the larger private drainage undertakings. Variations in the methods employed and the scope of the census have had the most effect on the number of projects covered but have not greatly affected the comparability of other items. The major changes have been (1) the elimination, in the enumeration, of numerous projects which had been taken over by a later project; (2) the exclusion of projects of under 500 acres which, because of their small size and tendency to represent overlapped projects, had contributed very little to the overall drainage area; (3) the consolidation into a single report of undertakings under common management; (4) the elimination of drainage undertakings representing an integral part of irrigation with the drainage required solely because of the irrigation of the land; and (5) the identification of extensive contiguous areas, within drainage projects, that were not used for agriculture or not drained. It will be noted that the changes listed under (1) and (3) had no effect on

the net area or drainage facilities covered in the census; the change under (2) reduced greatly the number of reports without any substantial reduction in the area or drainage facilities covered; the effect of the change stated under (4) was restricted to irrigated areas for which there was no need for drainage prior to irrigation; and the effect of the change listed under (5) was to provide more accurate data for lands which had been improved for agriculture by drainage.

Elimination of superseded projects.—In the first three censuses an attempt was made to obtain reports for all public drainage organizations, regardless of size, which had contributed to the investment and to the physical works represented in public drainage undertakings in existence at the time of the census. Reports were required for some organizations which had been wholly superseded by later projects. Quite commonly, a drainage organization had been established to provide a particular service and was dissolved or discontinued upon completion of the specified undertaking. When additional work was required, a new organization was created. In some counties the same land had been covered several times. For example, in 1940 in Ohio the total of areas of individual projects was more than 3 times larger than the total land area represented by all drainage projects in the State. (See Summary Table 8.) In the 1940 Census of Drainage Report, a distinction was made between "number of reports" and "number of enterprises," the latter intended to represent projects that had not been superseded by later organizations. For all drainage States reported in that census, the number of reports totaled 79,220, of which nearly half represented projects that had been superseded by later projects. Only 42,363 of these reports, or 53.5 percent, represented projects that had not been superseded.

The change in 1950, requiring the reporting of drainage activities for the most recent 10-year period, in lieu of an inventory of all physical works and the total capital investment represented by these works, made possible the elimination of reports which had contributed to the drainage works and to capital investment, but which no longer provided any drainage services. The effect of this elimination, in respect to number of reports, is shown by a comparison of number of projects, 1940, and number of reports, 1940. (See Summary Table 6.)

Elimination of projects under 500 acres.—A large proportion of the reports obtained in the first three censuses of drainage represented very small public drainage undertakings whose combined contributions to the overall totals were negligible. In 1940, more than half of the reports were under 500 acres but these small reports contributed only 5 percent to the net land area represented by all drainage projects. The decision to exclude public drainage projects of under 500 acres in the 1950 Census enumeration did not appreciably reduce the census coverage of drainage facilities but did eliminate the necessity of obtaining large numbers of reports that would contribute little significance to the statistics collected. Privately owned drainage projects of under 500 acres have been excluded from all five Censuses of Drainage.

A comparison of the total number of reports in 1940 and the number in 1940 excluding those representing fewer than 500 acres, is presented in Summary Table 6. Summary Table 11 provides a comparison of the totals of the acres in individual projects for all reports obtained in 1940 and for those under 500 acres. In making a comparison of the total areas, it should be kept in mind that nearly one-half of the totals of the acres of individual projects of under 500 acres represented land overlapped in other projects.

In 1950, although projects of less than 500 acres were eliminated from the enumeration, the data include 8,286 reports and 604,757 acres representing reports of under 500 acres of drained irrigated land reported in the Census of Irrigation.

One report for all drainage undertakings under same management.—More than four-fifths of all reports obtained in each of the first three censuses of drainage were from three States—Ohio,

Indiana, and Michigan. In each of these States, most of the drains were administered by county officials.

The decision in the 1950 Census to use one questionnaire to cover all drainage activities in each county in these and 7 other States greatly simplified the enumeration. (See "History of the Census of Drainage" and "County-drain" States.) It was no longer necessary to plot the land for every successive drainage activity. If records in the county provided totals for all drainage activities, it was not necessary to search out the data for each individual undertaking.

In these three States the number of reports obtained in the enumeration was reduced from 64,881 in 1940 to 196 in 1950. (See Summary Table 6.) A disadvantage of the procedure followed in 1950 was its failure to provide separate information for projects that were not under county management. These projects had been arbitrarily included in 1950 in the one report obtained for each county.

In 1960, the procedure was modified to obtain separate information for each project having its own separate organization but required, in all States, one report for all drainage undertakings under the same management. (For further discussion of the effects on the statistics of this enumeration procedure see "County-drain" States.)

Elimination of irrigation drainage.—In taking the earlier censuses of drainage, considerable difficulty had been experienced in obtaining satisfactory data for irrigation projects having their own drainage. In 1950, the reporting on the drainage questionnaire was so incomplete that it was decided to use the more limited data secured in the Census of Irrigation for that year. The drainage data available from the irrigation census were limited to the area of irrigated lands provided with artificial drainage and the number of projects reporting drainage. Some downward adjustments were made in these irrigation census data to eliminate drainage activities of separately organized drainage districts. Adjustments were limited to Florida, Louisiana, and Texas. The replies received in the 1960 mail canvass for irrigation enterprises indicated that there had been additional duplication which had not been eliminated. The exact location of the drained land reported in the 1950 Census of Irrigation had not been required. Consequently, no satisfactory check for duplications in the drained areas reported in the 1950 Census of Irrigation and those reported in the Census of Drainage was possible.

The decision, in 1960, to eliminate coverage of drainage required solely because of irrigation resulted in the exclusion, in that year, of most of the 9,076 reports and much of the 4,119,059 acres of drained lands reported in the 1950 Census of Irrigation and included in the 1950 drained land totals. Of these totals from the Irrigation Census, 8,286 reports, with 604,757 acres, were eliminated because of the 500-acre limitation. In addition to drainage performed by irrigation enterprises, the 1950 Census of Drainage included 267 drainage enterprises, organized separately, for which the drainage was principally for the purpose of removal of alkali or seepage from irrigated land. These 267 enterprises accounted for 1,270,729 drained acres in the 1950 total. The 1960 reports for most of these projects again indicated that the drainage was required solely because of irrigation and, therefore, were excluded from the tabulations.

Identification of nonagricultural and nondrained lands.—In the 1950 Census of Drainage Report, the total land in drainage projects for 40 small geographic areas—22 parishes in Louisiana; 4 counties each in Florida and Michigan; 3 counties each in Minnesota, Ohio, and Texas; and 1 in Arkansas—exceeded the total land in farms by 20 percent or more. The excess for these 40 small geographic areas amounted to 10,150,825 acres, or 9.9 percent of the total land in drainage projects reported for all drainage States.

In 1960, the determination of extensive nonagricultural and nondrained tracts within all drainage projects resulted in the identification of 9,573,393 acres, or 9.4 percent of the land in drainage projects, as not being used for agriculture or not benefited by the drainage works provided. The inquiry, which allowed for the determination of such land, permitted the identification and exclusion of former drainage district lands which now represent special use areas, such as State forests, wildlife refuges, recreation areas, etc. Similarly, it aided in identifying lands which had been withdrawn from an existing district for one or more of these special uses. Also excluded from the total area were large areas of swamp or waste lands and other nonbenefited areas in so-called countywide drainage districts. In 1960 the enumeration procedure called for the inclusion of only the portion taxed, if special levies were made against landowners directly benefited, or the portion actually improved if the entire county was taxed. In 1950, the entire area of the county was included.

Differences in reporting overlapped areas.—The consolidation into a single report of two or more undertakings under common management did not allow for the reporting of areas provided with supplemental services.

The land area in drainage projects, counting only once land in two or more projects, was accomplished in 1920 and 1930 by determining for each project the area not represented in an earlier project, whereas, in 1940 and 1950, this was accomplished by determining the area not in a later project. In 1960, the determination was made through the use of a worksheet which provided for counting only once each piece of land represented in the plotting of the projects on the county map.

In Summary Table 8, which presents data on areas served by two or more projects, the 1960 area is that which was provided drainage services by two or more projects. The 1950 totals for overlapped areas were obtained by subtracting from the sum of the acres of individual projects the net land area represented by all projects. The 1940, 1930, and 1920 totals for overlapped areas were, likewise, obtained by difference and were further affected by the inclusion of projects which had been superseded by later projects. (See "Elimination of superseded projects.")

In Summary Tables 12 and 13, land in two or more projects was included in 1960 for each project, thus representing multiple counting of such lands. For 1950 and 1940, only land not taken over by a later project was included. For 1930 and 1920, only land not represented in an earlier project was counted. In Summary Table 13, the area presented by year the project was started or organized represents, for 1950 and 1940, the area by year of beginning of the most recent drainage undertaking, while the 1930 and 1920 data represent more nearly the year drainage was first established for the area.

"County-drain" States.—The grouping of States, similarly affected by changes in procedure, permits a better comparison of historical data. The group of States most affected by changes in procedure were the 10 States designated in the 1950 report as "county-drain" States.

The simplification of the 1950 questionnaire and the use of only one report in 1950 for each county, for these 10 States, resulted in the omission of inquiries on pump drainage, year and type of organization, and overlapping of drainage projects. In presenting drainage data in 1950, for these States, no count was shown for number of projects and no classification was shown for type of project, year of organization, or size of project. In this report, the count shown for 1950 is the number of counties for which a report was included. In the 1960 presentation, each of the 1950 county reports was considered as presenting a legally organized drainage project and was classified by size on the basis of the total acres reported for the county. The possible inclusion in the county report of undertakings of individual landowners or of cooperating groups of landowners without formal organization under State laws was disregarded.

In 1960, the determination of the year started or organized for a combined report represented the year the management was established, or the year the first drain was started if the management preceded the drainage activities. The determination of the land for which drainage had been established since 1950, however, provided a measure of new undertakings for organizations established before 1950.

Except for Delaware, the predominant type of drainage organization in the so-called "county-drain" States was the county drain. For most counties in these States, the 1960 procedure provided data very comparable to those in 1950. The change in procedure affected only counties having drainage organizations not classed as county drains. For Delaware, since the predominant type of drainage organization was the drainage district, under the 1960 procedure each district required a separate report. The combined report used in 1950 was retained in 1960, for Delaware, only for districts for which there was no organization in 1960. (See "Drainage projects by size.")

"Drainage-district" States.—This designation was used for all drainage States other than "county-drain" States. For these States, the predominant type was the drainage district and the 1960 and 1950 procedures more nearly paralleled those used in 1940. The most pronounced difference was in the reporting of irrigation drainage.

"Irrigation" States.—This designation is used for that group of "drainage-district" States for which the 1950 data included drained lands reported in the Irrigation Census. The effect on the data, of the exclusion in 1960 of drainage undertakings which had been required solely because of irrigation, was limited to these States and a few counties in the "county-drain" States.

"Other" States refer to those "drainage-district" States not affected by the method of handling irrigation drainage. These States were least affected by changes in procedures.

SUMMARY OF DRAINAGE ACTIVITIES

The total area in drainage projects serving agricultural lands, as determined in the 1960 Census, was 101,870,257 acres. This area, benefited by drainage projects of 500 or more acres, is less than the 102,688,331 acres reported in 1950 but actually represents an increase for comparable categories of land. The 1960 data did not include approximately 3 million acres of drained irrigated lands and about 6 million acres of swamp and waste lands counted in 1950 but excluded under the 1960 procedures.

Of the 1960 total area of 101,870,257 acres within drainage project boundaries, 9,573,393 acres represented extensive areas either not being used for agriculture or not benefited by drainage works established by the projects. The remaining 92,296,864 acres, after the exclusion of extensive nonagricultural and nondrained lands, represented the area predominantly agricultural which had been benefited by installed drainage works. However, this total contained an unknown amount of interspersed non-agricultural land. Drainage was reported, as newly established since 1950, on 5,336,593 acres. This newly established drainage area represented both improvement of lands already in agriculture and the reclamation of new lands for agriculture. One-third of these newly drained lands represented additions to drainage projects in existence in 1950 and two-thirds, lands for which drainage works were established by projects started since 1950.

Projects initiated since 1950 also included new works or services for 2,637,792 acres on which drainage had been previously established. A large proportion of these newly established projects were undertakings of groups of farmowners cooperating without legal organization or undertakings of individual farmowners. The acreage of benefited lands of individual landowners and cooperative groups was approximately $2\frac{3}{4}$ times that reported in 1950.

In 1960, projects started prior to 1950 accounted for 93.6 percent of the total agricultural lands reported as provided with drainage.

Three-fifths of these older projects reported drainage activity in the period 1950 to 1959, with one-fifth reporting construction of new drainage works. Approximately one-fifth of those providing new works since 1950 had extended their facilities to lands not previously drained. Two-fifths of the projects started before 1950 reported no maintenance or other drainage services provided since 1950. Maintenance work on public drains by individual landowners would not have been included in the reports for public drains.

The total cost of drainage works and services for the 10-year period amounted to \$416,875,865, of which \$185,688,673 was for new works. New facilities represented, principally, construction of 33,543 miles of open ditches; 2,192 miles of tile or covered drains; 2,017 miles of levees; and the installation of 957 pumps. Costs for maintenance and operation of established drains, exclusive of any maintenance for public drains by individual landowners, amounted to \$2.50 per acre drained, or 25 cents per acre per year.

The greatest portion of the agricultural land in drainage projects is located in the North Central States and lower Mississippi Valley. The States with the largest drained acreage in 1960 were Indiana with 11,053,446 acres, Minnesota with 10,560,808 acres, Michigan with 9,877,049 acres, Ohio with 8,809,415 acres, and Louisiana with 7,110,624 acres. These five States accounted for more than one-half of the total drained agricultural land. These

States were followed in order by Iowa with 6,871,339 acres, Texas with 5,691,130 acres, Illinois with 5,563,426 acres, and Florida with 4,855,327 acres.

Three States accounted for more than one-half of the land on which drainage had been newly established since January 1, 1950. These three States were Minnesota with 1,244,237 acres on which drainage had been newly established, Louisiana with 965,687 acres, and Florida with 548,956 acres. Other leading States were Texas with 318,198 acres, North Carolina with 254,482 acres, Mississippi with 249,368 acres, California with 244,352 acres, and Arkansas with 233,263 acres. These eight States accounted for more than three-fourths of the total land on which drainage had been established since January 1, 1950.

Florida led all States in the amount spent for agricultural drainage for the 10-year period, 1950 to 1959, with a total cost of \$91,627,636 for all drainage works and services. Of this total, \$68,012,516 represented an outlay for new construction. Florida accounted for more than one-fifth of the total reported by all States for drainage works and services and more than one-third of the total cost of new works. Louisiana reported a total expenditure of \$45,796,344, and Minnesota, \$41,809,993, with more than one-half of each total representing new works. Michigan followed with a total cost of \$37,186,074, of which \$32,402,708 was for maintenance, the largest amount of maintenance reported for any State.